Claims

1. A vehicle guidance system (1) comprising means for detecting position of a vehicle (30) and a processor (2) for generating operator instructions to assist the operator to manoeuvre the vehicle, characterised in that

   the system comprises range sensors (3-7) and means for using outputs of the sensors to dynamically maintain a space map (12) in real time;

   the system comprises an operator model of operator capabilities; and

   the processor (2) comprises means for planning a path to a goal position (33) in a confined space using data from the operator model (11) of operator capabilities and data from the space map (12)

2. A vehicle guidance system as claimed in claim 1, wherein the system comprises means for maintaining the space map (12) as a set of polygons each defining a spatial area.

3. A vehicle guidance system as claimed in claim 2, wherein said space map (12) maintaining means comprises means for processing three-dimensional space data from the sensors and for breaking said data to two-dimensional space data in a polygon framework.

4. A vehicle guidance system as claimed in claim 2, wherein said space map maintaining means comprises means for maintaining a flag for each polygon, said flag indicating if the polygon is occupied by an object.

5.   A vehicle guidance system as claimed in claim 1, wherein the operator model (11) comprises time parameter values for the operator to perceive information, for the operator to cognitively process information, and for neuromuscular delay for implementing an action.

6.   A vehicle guidance system as claimed in claim 5, wherein the operator model (11) comprises a parameter value for spatial error for performing an action.

7.   A vehicle guidance system as claimed in claim 1, wherein the processor comprises means for storing a vehicle model (10) of movement characteristics of the vehicle (30).

8.   A vehicle guidance system as claimed in claim 1, wherein the processor (2) comprises path planning means for planning (24) a plurality of sub-goals forming a path to the goal position (33).

9.   A vehicle guidance system as claimed in claim 8, wherein the path planning means comprises means for determining a sub-goal only if it can be achieved with a single manoeuvre of the vehicle (30) and if it is instructable to the operator.

10.   A vehicle guidance system as claimed in claim 8, wherein the path planning means comprises means for determining (47) a set of candidate trajectories for reaching the goal position (33) with collision avoidance, and for performing backchaining to break each candidate trajectory into a plurality of sub-goals starting from the goal position (33) and extending back to the current position (32).

11. A vehicle guidance system as claimed in claim 10, wherein the set of candidate trajectories is determined by generating (47) a first set of candidate trajectories compatible with the space and the vehicle models (10, 12), and for subsequently reducing (48) the first set to those compatible with the operator model (11).

12. A vehicle guidance system as claimed in claim 10, wherein the path planning means comprises means for dynamically repeating path planning (24) in real time at each of a plurality of vehicle positions.

13. A vehicle guidance system as claimed in claim 1, wherein the vehicle model (10) is for a boat, and the sensors comprise a sonar device (3), a laser range finder (4), a vision system (5), a radar system (6), and a GPS circuit (7).

14. A guidance system substantially as described with reference to Figs. 1 to 7.

15. A guidance system substantially as described with reference to Fig. 8.

16. A vehicle comprising a guidance system as claimed in claim 1.

17. A method of guiding a vehicle from a current position (32) to a goal position (33) in a confined space, the method comprising the steps of:-

        range sensors (3-7) automatically sensing objects around the vehicle (30),

a processor using outputs of the range sensors to dynamically maintain a space map (12) in real time,

the processor planning a path to the goal position (33) using data from the space map (12) and from an operator model of operator capabilities,

an output interface (16-19) outputting instructions to the operator for movement of the vehicle according to the planned path, and

the operator moving the vehicle according to the instructions.

18. A method as claimed in claim 17, wherein the processor generates instructions for the operator for movement of the vehicle in a single manoeuvre at a time.

19. A method as claimed in claim 17, wherein the processor performs backchaining to break down a path into a plurality of sub-goals, and generates an operator instruction to achieve each sub-goal in turn.

20. A method as claimed in claim 19, wherein the processor repeats path planning at each position on the basis of the current position.

21. A method as claimed in any of claim 17, wherein the processor generates the operator instructions also using data from a vehicle model of vehicle movement characteristics.